

## SHORT COMMUNICATION

### Military base growth in Afghanistan: a threat to scorpion populations?

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**Abstract.** Coalition military bases in Afghanistan are increasing in area, infrastructure and population due to increased military efforts. From 2004 to 2010, a 40-hectare base in Ghazni, Afghanistan transitioned from a montane shrubland to a small, modern “village.” This shift comprised an over 50-fold increase in hardcover and a 20-fold increase in the human population. I searched the base with UV light ( $n = 43.6$  h) for scorpions, especially *Mesobuthus* Vachon 1950, an established, opportunistic scorpion found in Ghazni City, 5 km north. I completed my searches along two tracks ( $> 5$  km total length) and considered all habitats for this scorpion. Anthropogenic microhabitats comprised concrete walls, concrete barriers, gabions or sandbags, each in contact with a dirt or gravel substrate (eight possible); all were thermally appealing (mean = 2.3°C warmer than ambient temperature). Despite the population of *Mesobuthus caucasicus* Nordmann 1840 in Ghazni City and the increase in thermally attractive microhabitats on the base, I found no scorpions. I propose that the rapid anthropogenic change due to base improvements outpaces the capacity of this scorpion to disperse to a new, albeit satisfactory, environment. Here, I report my observations of scorpion diversity and abundance in east-central Afghanistan and the Hindu Kush Mountains, with a focus on the impact of increasing anthropogenic change upon the environment.

**Keywords:** U.S. Army, anthropogenic change, microhabitats, Asia

Due to wars and an unstable political climate in Afghanistan, our understanding of Afghanistan’s flora and fauna lags behind that of other Asian countries (UNEP 2009). For example, Vachon’s (1958) comprehensive review of scorpions in Afghanistan is more than 50 years old. His study focused, moreover, on areas near population centers such as the capital region (Kabul) and the Sistan Basin (Kandahar, southwestern Afghanistan). The current U.S.-led War on Terror in Afghanistan is having a two-fold effect—generating both increased infrastructure and increased interest in Afghanistan’s environment (e.g., UNEP 2009). Here, I report my observations of scorpion diversity and abundance in east-central Afghanistan and the Hindu Kush Mountains (Fig. 1), with a focus on the effect of increasing human impact upon the environment.

The U.S.-led coalition, along with the Afghan National Army, currently operates over 700 military installations in support of the War on Terror in Afghanistan (Turse 2010). These Forward Operating Bases (FOB) range in size from small, mountaintop outposts occupying a few tens of square meters to grand, city-sized logistical centers, such as Bagram Airfield near Kabul, which is over 1,000 hectares in size. Regardless of their size, where they are located or how long they have been there, these bases are having a significant ecological impact. FOB Ghazni, located in east-central Afghanistan, has been occupied for about eight years and currently houses approximately 1,000 Polish and American soldiers. Based on direct observations, collection of photogrammetric data and personal interviews with local leaders, FOB Ghazni has grown significantly in these eight years.

Ghazni Province is located in semi-arid, east-central Afghanistan in the Hindu Kush Alpine Meadow ecoregion (Olsen et al. 2001). The region is mountainous and intersected by fault-controlled valleys with regional elevations ranging from approximately 2,000 to over 4,500 m asl. My observations show that the valley and alpine meadow areas (including FOB Ghazni) are comprised of primarily sandy loam to loamy fine sands with intermittent camel weed (*Cymbopogon schoenanthus* Spreng.), sagebrush (*Artemisia* sp. L.), salt cedar (*Tamarix* sp. L.) and grasses such as *Poa bulbosa* (L.). The most common vertebrates spotted were the yellow ground squirrel (*Spermophilus fulvus*, Lichtenstein 1823), jerboas (*Dipodidae* de Waldheim 1817), rats/mice (Murinae Illiger 1811) and agamid lizards

(*Trapelus* sp. Olivier 1804). Common invertebrates included ants (Formicidae Latreille 1809), cockroaches (Blattodea von Wattenwyl 1882), crickets (Gryllidae Bolivar 1878), spiders (Araneae Clerck 1757), occasional sun spiders (Solifugae Sundevall 1833) and three species of scorpions (this study).

*Mesobuthus caucasicus* (Nordmann 1840) and *Mesobuthus eupeus* (Koch 1839) (Scorpiones: Buthidae) are medically important species (Chippaux & Goyffon 2008) distributed from the Balkan Peninsula to China (Fet et al. 2000). Adults of these species vary in color from light yellow-brown to brownish and can reach lengths greater than 5 cm. The third scorpion is in the genus *Hottentotta* (Birula 1908) (Buthidae), some of which are also medically important (Chippaux & Goyffon 2008). *Hottentotta* are present throughout Africa, the Arabian Peninsula, and in Asia to Pakistan and India, with adults usually a uniform yellow-brown, sometimes with a darkened mesosoma, ranging 3–13 cm in length (Kovářík 2007).

I used photogrammetric techniques on satellite images from 2006, 2008 and 2010 to collect FOB Ghazni infrastructure changes; data collected for 2004 (inception of the FOB) and earlier were from an interview with the Ghazni Director of Agriculture, Irrigation and Livestock, Haji Sultan Hussein Usman Usmani. Human population estimates are based on the 2001 Taliban-run madrasah population and the January 2010 population.

FOB Ghazni infrastructure and population have grown significantly as a result of troop build-up in Afghanistan (Turse 2010). From its inception in 2004, its paved/gravelled area has increased 54 times from approximately 6,000 m<sup>2</sup> to over 325,000 m<sup>2</sup>; its building number has increased from one to over 400 structures; its structure area has increased nearly 34 times from 1,500 m<sup>2</sup> to over 51,000 m<sup>2</sup>; and it is estimated that the population has increased from dozens to over 1,000.

I collected ambient environmental data (e.g., temperature, humidity and barometric pressure; Table 1) almost nightly at approximately 20:45 hrs, from 13 May 2009 to 16 September 2009 with a digital weather device. In addition, I collected microhabitat temperatures during each nightly survey with an Extech IR thermometer gun (#42540; range: –50–760°C; 16:1 distance:target resolution).

The weather at FOB Ghazni, at approximately 20:45 hrs, for the period 13 May 2009 to 16 September 2009, averaged 20.3°C, 773 mb

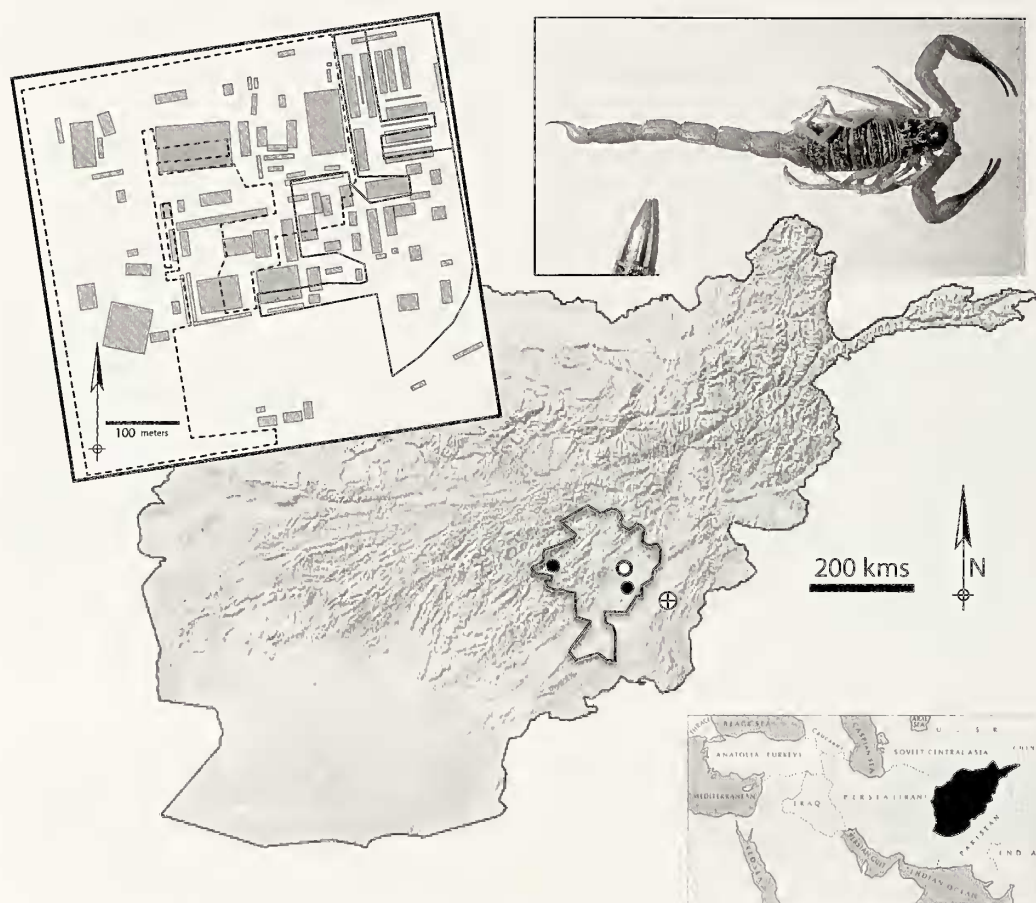


Figure 1.—Map of Afghanistan showing Ghazni Province (outlined) and collection sites (black-filled circles represent *M. eupeus* collection, white-filled circle represents *M. caucasicus* collection and crosshatched circle represents collection of *M. eupeus* and *Hottentotta sp.* (see Table 2)). A generalized map of FOB Ghazni (located at the white-filled circle) is overlaid showing approximate building distribution (gray polygons) and search tracks (dashed and solid lines). A photograph of a collected *M. eupeus* is inset (maximum width of bullet is 5.5 mm). Shaded relief map is modified from NASA.gov, and the regional map is modified from marykellykilims.co.nz.

atmospheric pressure and 27% relative humidity (Table 1). Micro-habitat temperatures, also at that time, averaged 2.3°C warmer than ambient evening temperatures (Table 1).

Mr. John Kornman, vector-control specialist on FOB Ghazni, provided me with over two years of vector-based disease control data, which supported Department of Defense (DoD) efforts to minimize pest infestation problems (Goddard 2008). Vector data were compiled by observations, reports and glue-board traps. Although glue boards are the least sensitive of pest traps, they are inexpensive and easy to manage; currently, it is unknown whether scorpions are responsive to these traps (cf. Arthur & Phillips 2003). Approximately 50 to 60 of these were dispersed around the base at any given time and, as an estimate of their usage, approximately 300 were employed between April and July of 2009. Glue boards were checked two to three times weekly. Chemical treatments (e.g., Deltamethrin) were dispensed only in targeted areas – no base-wide broadcasting was allowed (DoD 2008). These treatments were applied to cracks and crevices with a hand duster and were considered methods of last resort.

From September of 2007 to November 2009, vector-control specialists on the base found no scorpions by observation, reporting or trapped on their glue boards. The primary arthropods found during vector-control operations were flies, ants and roaches.

I completed a scorpion survey of FOB Ghazni by searching two tracks (Fig. 1), which were planned based on previous scorpion-collection experience at Forward Operating Bases in Iraq during the summer of 2004 (cf. Stewart 2006a, 2006b, 2007). These searches included all possible microhabitats on the FOB, covering the general

ground surface and the eight possible anthropogenic microhabitats (Table 1): two substrata (gravel or dirt) in contact with four vertical surfaces (i.e., HESCO (fortification) barriers, sandbags, concrete barriers or buildings). These tracks were searched, on foot, separately or combined for up to 90 min during Nautical and Astronomical twilights from 13 May 2009 to 16 September 2009 using a multi-bulb UV LED light (~385nm, 4.0mW). In 43.6 hours of UV-light searching of FOB Ghazni, I found no scorpions.

Despite the lack of scorpions on the FOB, Lieutenant Colonel Piotr Lewandowski, Polish Army, Mr. John Kornman, FOB Ghazni vector-control specialist and Mr. Zainallah Bodeen, souk merchant, found scorpions locally and regionally. They collected scorpions at five different off-FOB locations (Table 2) by means of rock-rolling, hand-held UV light and in-house capture. These specimens were brought to the author at the FOB alive and were subsequently killed in 99°C water and preserved in a saturated saline solution (39%) in order to bypass USPS shipping restrictions. Specimens were labelled and shipped to Victor Fet at Marshall University, West Virginia, USA for tentative identification and storage until I returned from Afghanistan. Specimens were washed and stored in 90% isopropyl alcohol and are currently housed at St. Lawrence University.

Seventeen specimens were collected off the FOB (Table 2). Nine specimens of *Mesobuthus eupeus* were located while gathering cobbles from an approximately 2,500-m<sup>2</sup> meadow in the Malistan District, approximately 125 km west of the FOB, inferring a density of one specimen every 250 m<sup>2</sup>. One specimen of *M. eupeus* and one specimen of *Hottentotta sp.* were collected in Paktika Province, approximately



Table 1.—Environmental and microhabitat temperatures for FOB Ghazni between May and September 2009. Microhabitat temperatures are at the interfaces of the following elements: “H” is HESCO barrier, “R” is rubble, “D” is dirt, “S” is sandbag, “C” is concrete and “B” is building.

Environmental/Ambient weather data ( <i>n</i> = 53)					Microhabitat temperatures (°C) ( <i>n</i> = 53)								
	Time	Temperature (°C)	Barometer (mb)	Humidity (% relative)		H-R	H-D	C-R	C-D	S-R	S-D	B-R	B-D
Mean	2045h	20.3	773	27	Mean	23.1	21.8	24.1	23.9	23	21.7	21.9	22.3
Max	2130h	25.6	780	35	Max	28.9	27.7	30.1	31.7	30.9	28.1	25.7	26.8
Min	2000h	5	767	21	Min	11.9	11.2	12.3	9.9	11.7	12.4	13.1	12.6

100 km southeast of the FOB, from a derelict, early 19<sup>th</sup>-century British fortification made of adobe and rocks where they were found roaming within 1 m of the ground-wall interface. Three specimens of *M. eupeus* were collected in a rubble pile at a small, undeveloped firebase in the Giro District, approximately 50 km south of the FOB. Three *Mesobuthus caucasicus* were collected in and around a home in Ghazni City, 5 km north of the FOB. This collection of 17 scorpions expands the work of Vachon (1958) by extending the known distribution of *M. eupeus*, *M. caucasicus* and *Hottentotta* sp. into east-central Afghanistan. It, moreover, corroborates Vachon's (1958) altitudinal distribution of *M. eupeus* up to approximately 3,500 m asl. and increases the known altitudinal distribution of *M. caucasicus* in Afghanistan from approximately 1,700 m asl. (Kabul area) to approximately 2,200 m asl. in Ghazni City.

Studies on the anthropotolerance (anthropophily) of scorpion fauna are quite rare (cf., Crucitti et al. 1998). Instead, a scorpion's preferred habitat is usually inferred from observations during collection. Early workers (e.g., Birula 1917) made generalizations about scorpions and human habitats that have mostly been accepted, but not tested. Recent studies, more concerned with their conservation and medical importance than faunal and ecological descriptions, are beginning to highlight scorpion-human interactions (e.g., Vignoli et al. 2005; Mirza & Sanap 2010). Crucitti et al. (1998) suggest that in urban habitats, such as Rome, Italy, various factors enable the maintenance of large scorpion populations in a complex urban epigeal system, which generates favorable microclimatic conditions. They found that scorpions preferring limestone microhabitats were selective of urban microhabitats that mimicked a limestone environment (e.g., brick walls in old cellars). McIntyre (1999) suggests that anthropogenic change, as a result of home construction, reduces scorpion-sting occurrence. Basically, the author recommends higher density housing, which minimizes direct contact with undisturbed scorpion habitats.

Because there is no documentation of scorpion populations in this region of Afghanistan, it is my assumption that the FOB's location was suitable for scorpions prior to its establishment. Having demonstrated scorpion populations elsewhere in the region with no evidence of scorpions on FOB Ghazni, suggests that anthropogenic changes may have eradicated any incipient scorpion populations (i.e., *M. eupeus*) on the base.

The primary reason for the lack of scorphofauna on FOB Ghazni is the use of gravel pavement. Since the base's inception, base personnel have covered areas of high-human use with gravel to reduce dust. As

of 2010, gravel pavement covers over 80% of the base to an average depth of 5 cm (over 3,000 m<sup>3</sup>). This pavement, however, is unsuitable to scorpions. Humans are changing scorpion habit from a suitable, sandy, sparsely vegetated terrain to an unsuitable, rocky pavement.

Conversely, increases in infrastructure can also allow an increase in microhabitats (e.g., Crucitti et al. 1998). The primary reason for anthropogenic scorpion habitat proliferation is from increases in building number and area. These new structures are creating microhabitats, similar to those found in Ghazni City, that appear to be preferred by the generalist/opportunistic scorpion *Mesobuthus caucasicus*. My data show these microhabitats to be thermally appealing, staying warmer than the ambient air temperature during the high-altitude, cool-summer nights (Table 1).

Combining these two issues, a) incipient eradication and b) increase in microhabitats, can help predict what may occur once this FOB's growth stabilizes. Based on the 16 *Mesobuthus* specimens collected and their chosen habitats, it is probable that the dominant scorpion population during the establishment of the FOB was *Mesobuthus eupeus*, which is thought to be anthropophobic (Birula 1917; Fet 1994). All *Mesobuthus* specimens collected from alpine meadows and derelict structures were *Mesobuthus eupeus* (13 of 16), agreeing with Birula (1917) and Fet (1994) that they do not live well with human activity. The remaining *Mesobuthus* specimens (3 of 16) that were collected in Ghazni City, however, were *Mesobuthus caucasicus*, which are synanthropic animals and thrive with humans (Birula 1917; Fet 1994). The remaining *Hottentotta* specimen appears to be an outlier and of no value in interpreting scorphofauna associated with anthropogenic change.

It appears that military base growth has had the unintended effect of eradicating a *M. eupeus* population through dust-abatement techniques. Initial increase in human activities at FOB Ghazni may have eradicated a *M. eupeus* population. Based on observations of *M. caucasicus* cohabitating in human dwellings in Ghazni City, stabilization of base growth, with continued human activity, may allow the dispersal and stabilization of pioneer, synanthropic *Mesobuthus caucasicus* into new, thermally appealing anthropogenic microhabitats.

Based on the December 2011 end of the war in Iraq, however, it appears military bases are not long lived. The resultant exodus of coalition troops from Iraqi bases has left them as ghost towns and monuments to a once-thriving war (Hodge 2011). This suggests that military bases in Afghanistan may never “stabilize” into functioning, human habitats. It seems, however, they will become derelict like their

Table 2.—Scorpion collection data.

Collection Date	Location	Grid	Elevations (~m)	#	Species	Sex (♂,♀)	Collector
25 May 2009	Malistan District, Ghazni, AF	33.34N, 67.11E	3,300	9	<i>Mesobuthus eupeus</i>	6,3	Lewandowski
25 May 2009	Gomal, Paktika, AF	32.76N, 69.05E	2,000	2	<i>M. eupeus</i> & <i>Hottentotta</i> sp.	1,0 & 1,0	Kornman
17 July 2009	Giro District, Ghazni, AF	33.09N, 68.33E	2,100	2	<i>M. eupeus</i>	1,1	Kornman
13 August 2009	Giro District, Ghazni, AF	33.09N, 68.33E	2,100	1	<i>M. eupeus</i>	0,1	Kornman
2 September 2009	Ghazni District, Ghazni, AF	33.56N, 68.41E	2,200	3	<i>M. caucasicus</i>	1,2	Bodeen

Iraqi counterparts, leaving long-term, unsuitable environments for both *M. caucasicus* and *M. eupeus*. The lack of an active, human environment (i.e., heated) and the impervious pavement may essentially sterilize these FOB areas for the near future. A survey of operating bases in Afghanistan in the years to come may help elucidate whether either scorpion species is able to establish itself in this highly modified terrain.

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